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VOL. 20 DECEMBER 1961 NO. 3

THE GEORGE WASHINGTON UNIVERSITY · SCHOOL OF ENGINEERING

THE GEORGE WASHINGTON UNIVERSITY

DECEMBER 1961

A second sun: made in U. S. A.

The sun produces energy through nuclear fusion—a gigantic hydrogen explosion that has been going on for more than 500 million years. We may duplicate it. Scientists at Princeton University are experimenting with a *Stellerator* to attain controlled nuclear fusion that will produce endless energy from the hydrogen in sea water. The Stellerator is supported by 17 USS Quality Forgings that could be made from only one material —a new, non-magnetic Stainless Steel called Tenelon, developed by United States Steel.

Although the Stellerator is strictly experimental, there would be no nuclear programs of any type without steel. The very heart of an atomic generating plant—the reactor vessel—must be steel, whether it's the power plant of a nuclear submarine or a commercial generating station. In addition to the reactor, the power station literally bristles with tons of special steels developed in the laboratories and produced in the mills of United States Steel. If nuclear power is the door to America's future, the key is steel. *America Grows With Steel.*

For information about the many career opportunities, including financial analysis or sales, write U. S. Steel Personnel Division, Room 6085, 525 William Penn Place, Pittsburgh 30, Pa. U. S. Steel is an Equal Opportunity Employer.

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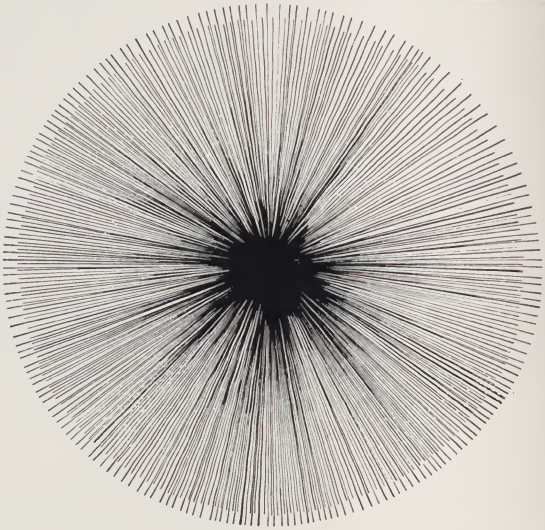
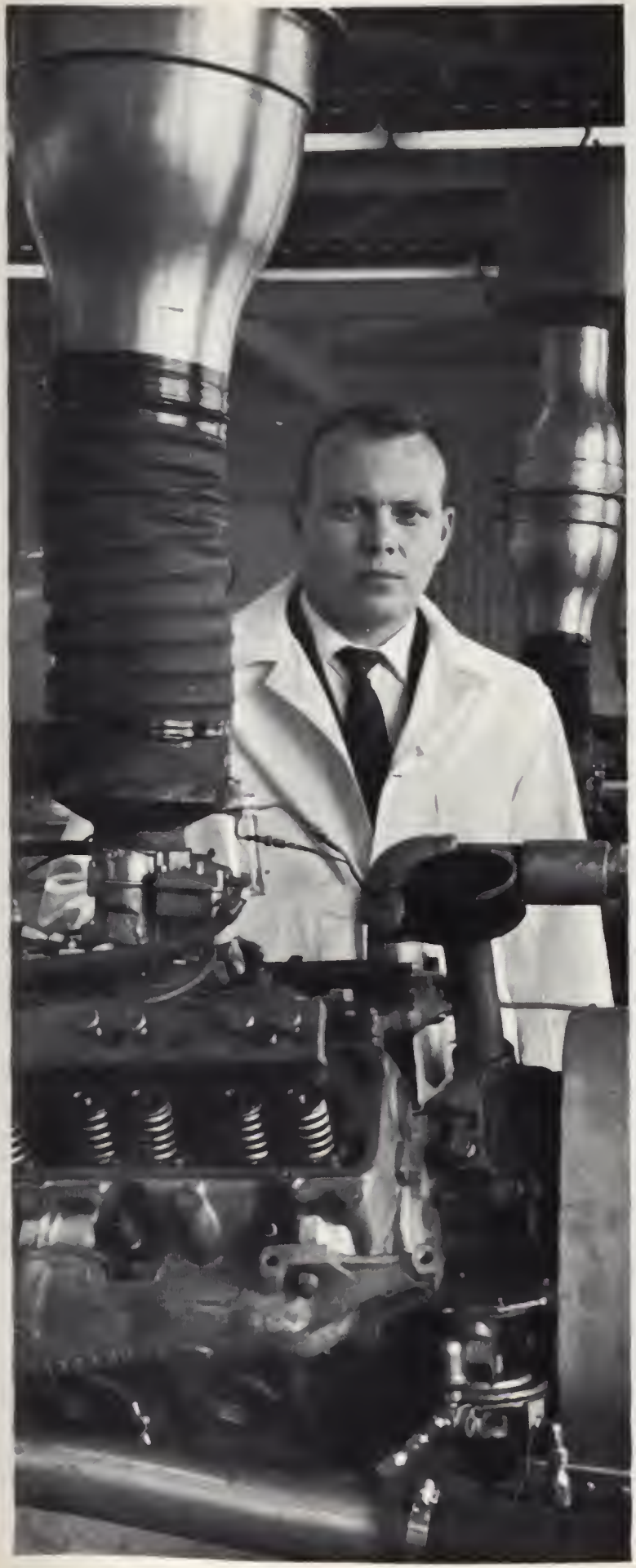


United States Steel USS



Good reasons why I chose American Oil

by Don Anderson

"Here you're treated as an individual. The Company respects and recognizes individual achievement. The work is challenging and affords the chance to use your own ingenuity."

That's Don Anderson talking, 31-year-old mechanical engineer engaged in testing lubricants at American Oil Company. Don spent six years in the military service prior to earning his Bachelor of Science degree at the University of Illinois. Don, the father of two children, explains, "The routes to the top are many and varied. There's plenty of opportunity for advancement —and that's the best kind of job security I can think of."

The fact that American Oil attracts talented college graduates like Don Anderson may have special meaning to you as you plan your career. Don is one of many young scientists and engineers at American Oil who are growing professionally in a wide range of research projects. There are challenging opportunities in many areas. Chemists, chemical engineers, mechanical engineers, physicists, mathematicians and metallurgists can find interesting and important work in their own fields.

For further details about the rewarding career opportunities at American Oil Research and Development Department, write to: D. G. Schroeter, American Oil Company, P. O. Box 431, Whiting, Indiana.

IN ADDITION TO FAR-REACHING PROGRAMS INVOLVING FUELS, LUBRICANTS AND PETROCHEMICALS, AMERICAN OIL AND ITS ASSOCIATE COMPANY, AMOCO CHEMICALS, ARE ENGAGED IN SUCH DIVERSIFIED RESEARCH AND DEVELOPMENT PROJECTS AS: New and unusual polymers and plastics • Organic ions under electron impact • Radiation-induced reactions • Physiochemical nature of catalysts • Fuel cells • Novel separations by gas chromatography • Application of computers to complex technical problems • Synthesis and potential applications for aromatic acids • Combustion phenomena • Solid propellants for use with missiles • Design and economics: New uses for present products, new products, new processes • Corrosion mechanisms • Development of new types of surface coatings.

AMERICAN OIL COMPANY

The Mechelectiv

VOL. 20 DECEMBER 1961 NO. 3

ARTICLES

DEPARTMENTS

Published at the George Washington University by direction of the Engineers' Council. Published six times during the school year in October, November, December, March, April, and May. Entered as second class matter March 6, 1951, at the Post Office at Washington, D. C., under the act of March 3, 1879. Address communications to Mechelectiv Magazine, Davis-Hodgkins House, George Washington University, Washington 6, D. C. or telephone FEderal 8-0250, Extension 528.

Subscription Price: Two Dollars

CHANGE OF ADDRESS: Send your new address at least 30 days before the date of the issue with which it is to take effect.

Editorial Page

What will your profession be when you graduate, engineering or technical? Will you be satisfied with the status of your degree?

It is only fair that the public should demand that every professional person should hold an accredited degree, in the field of his profession. An accredited and publicly recognized degree in engineering at George Washington University is to the advantage of all graduates of The School of Engineering; past, present or future.

Every graduate of The School of Engineering has a duty to promote the "public image" of George Washington University and its various degree programs, if only to promote a more meaningful acceptance of your professional status. The graduates of George Washington University are no better than the caliber of the students who study here.

We who are students here at The School of Engineering, are striving to promote the true academic life and future profession of the engineering student; as well as to raise the outlook of the public on the quality of engineering at George Washington University. Each of you may help promote The School of Engineering on Feb. 23 & 24 by participating in the student sponsored Engineer Days.

John Wolfgang

WRGW

RADIO ACTIVITY ON CAMPUS

by Michael Cogan, Program Director

WRGW, four up-and-coming letters around campus, are the call letters of George Washington University's radio station. Although founded four years ago, the station has been broadcasting regularly only since the beginning of the present semester. Previous failure was due to the extreme technical problems facing the staff. Now, however, WRGW is on the air regularly, and its audience is growing rapidly.

The station's programs, originating in studio F of Lisner Auditorium, are piped through telephone lines to Madison and Strong Halls, the only buildings presently equipped to receive the shows. In each building, the signal modulates a transmitter which broadcasts on a frequency of 660 kc. The transmitters work on the carrier current principle which feeds the signal into the power lines. Standard broadcast radios within the buildings receive WRGW by the induction field surrounding all the power lines; at the same time, radiation outside the buildings is kept within F.C.C. regulations.

WRGW is presently on the air from 2-5 p.m. Monday thru Friday; additional "on-air" time is 7-11 p.m. Monday through Thursday.

The 2-4 p.m. spot is filled with light listening and popular music with the following disk jockies:

1. John Waller - Monday - "Records with Richard"

2. Kevie Bier - Wednesday - "Kevie's Korner"

3. Don Talley - Tuesday and Thursday - "Talley-Ho" and

4. Eli Fishlowitz - Friday - "T.G.I.F. Party"

Bob Tessler adds a madcap hour of fun, music, and riots from 4-5 p.m. Monday, Tuesday, and Wednesday; meanwhile, Jules Latham rounds out the week with rock and roll from 4-5 p.m. Thursday and Friday.

The mood is changed to some more serious listening in the later hours of the day as Mike Rivers comes on from 7-9 p.m. Monday and Wednesday with "The Contemporary Sound" (modern jazz), and Bob Felner completes the 7-9 p.m. week with "Seventh Hour Classics" on Tuesday and Thursday.

The program schedule has recently been expanded to include Aze Felner's "Potluck and Broadway" show from 9-11 p.m. on Monday and Wednesday; the new schedule also encompasses "New World Folksingers" with Mike Stewart as your record spinner, from 7-11 p.m. Tuesday and Thursday.

To fill in the remaining hours between 2 and 11 p.m. Monday thru Friday, the station has considered various musical, dramatical, and educational shows from the Intercollegiate Broadcasting System, of which the station is a member. Of course, helpful hints from listeners would simplify this choice.

WRGW, although seemingly well-organized and on its way, is still faced with two main problems:

The first is a lack of equipment and records. Although the present equipment is adequate for most studio operations, the station needs a good tape deck, some microphones, and more transmitters. At the moment, WRGW has no source of records beyond the private collections of the staff.

The second thing WRGW needs is more people to help in all aspects of running the station.

We therefore request that all persons wishing to volunteer services or equipment please call extension 686 on the university line, or come up in person to studio F of Lisner Auditorium during broadcast hours or from 11:30 a.m. to 1 p.m. on weekdays.

ELECTRONIC ILLUMINATION

Donald Hidy. Engr. I

Originally printed in the March, 1959, issue of the Ohio State Engineer

A REVOLUTIONARY process that promises to transform our present-day lighting methods and to make them as antiquated as the old kerosene lamp is now in its embryonic stage of development. This process is called electroluminescence.

This new "electronic light" was first discovered in the Sorbonne Laboratory of Georges Destriau in 1936; however, it has only been in the last ten years that this process has evolved as a commercial possibility. Among the major American companies that are doing research on electroluminescence are Westinghouse, General Electric, RCA, and Sylvania.

Basically there are four types of lighting. (1) Incandescence: this is produced in the ordinary light bulb when an electric force pushes electrons through a thin tungsten filament that is enclosed within an evacuated glass bulb. Here light is evolved as friction makes the filament white hot. (2) Fluorescence: electrically excited mercury atoms emit ultraviolet (invisible) light which is transformed into visible light upon striking phosphors that coat the inside surface of the fluorescent tube. (3) Cathode-ray: the cathode-ray (television) picture tube operates on the principle that as cathode rays or high energy electrons strike the phosphor screen they produce light at the point of impact. (4) The fourth and newest way to produce light is by electroluminescence. This is accomplished by applying a strong emf directly to the phosphor itself.

The electroluminescence lamp is basically a capacitor (or condenser), a direct descendant of the Leyden jar that Ben Franklin used in his kite experiment. One plate is steel or aluminum and the other is a transparent glass plate through which the light is emitted. The glass is coated by Corning with a transparent film of tin oxide which is a good conductor of electricity and which has a light transmission factor of about 80%. Between the plates there is a dielectric material to store electrical energy and which is impregnated with zinc sulphide powder and carefully measured "impurities" of copper sulfide, which is also a good conductor of electricity. (See Fig. 1)

When an electric field is introduced between the plates, electrons are freed from the phosphor-porcelain mixture shooting them into the phosphor crystals and these electrons in turn strike the phosphor atoms. Essentially, light is emitted by the copper sulfide-impregnated zinc sulfide crystals with each alternation of the current at which time electrons are bounced back and forth between different "bands" or energy levels within the crystal. If the frequency is high enough, then retension of vision enables us to see the light as a continuous emission. The amount of light produced is directly proportional to the voltage and to the frequency.

Electroluminescence has many advantages over other lighting processes. The apparatus will not break or burn out, the only cause for failure being a possible breakdown of the dielectric under excessive voltage. However, if the lamp is operated at or near its standard rating, its useful life is expected to be about 25,000 to 40,000 continuous operational hours. Theoretically, 5 cents worth of electricity should operate the entire lighting of a whole household for one year when it is perfected.

The light glows as a bright surface enabling whole walls and ceilings to be paneled. The panels can also be made into any desired non-rigid size or shape. Since electroluminescence is not limited to point or line sources, it produces a soft, shadowless, glareless light with uniform diffusion. At present the zinc sulfide crystals emit only nine lumens as compared to 16 for the 100-watt bulb and 60-70 for the fluorescent lamp. A "lumen" is defined as the quantity of light that falls on one square foot of the surface of a sphere with a one foot radius from ordinary candle at its center. However, scientists have determined that at full potential the electroluminescent lamp will produce 240 lumens as compared to 22 for the incandescent lamp and 100 for the fluorescent lamp. Also, electroluminescence can be produced in almost any color by varying the frequency or mixing different powders. For example, at 60 cps green light is emitted and at 10,000 cps blue light is emitted. The increase in exciting frequency shifts the light toward shorter

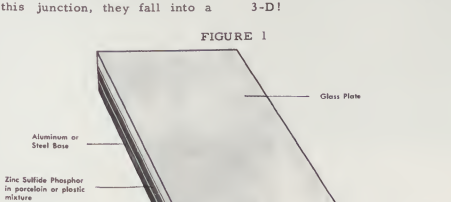
wave lengths, i.e., higher frequencies. Commercially, "panelescent" lamps are available for 120, 220, and 600 volt alternating current with a minimum of 25 cps. The lighting does not vary more than 10% for temperatures between 32° and 175°F.

Since higher frequencies and lower voltages are needed than are produced by our present household circuits in order to efficiently provide electroluminescence, it has not become a practicality as yet. Also, due to inefficiencies that are yet to be solved, electroluminescent lamps need approximately twice as much electricity as incandescent lamps and 7 to 8 times as much as fluorescent lamps. Also a deterrent to progress is the high state of purity that the crystals have to possess (which is approximately one part impure to a million parts pure).

Research is now being done on different types of crystals; such as silicon carbide. In silicon carbide there exists marked places of different concentrations of impurities and as electrons are pushed across this junction, they fall into a lower energy level and give off light and consequently only a few volts of electricity are needed. This is just one example of the research being done in the infant science of solid-state physics.

Westinghouse recently displayed 112 panels, each being one square foot and 1/8 inch in thickness, and using 350 volt, 3,000 cycle alternating current where just a few months earlier 10,000 cycle current was needed. Electroluminescence can also be used for "light amplification" whereby a dim image is thrown on the back of a panel and is converted into a much brighter picture on the screen. Likewise, X-ray images can be amplified and after the rays are turned off, the picture can be retained on the screen for longer, more detailed, medical examination while using 1/30 of the radiation and greatly reducing the amount of electricity required. Electroluminescence in decoration, advertising, and lighting. Perhaps, by 1975, as the scientists predict, we will have seen TV sets disappear and in their place we will have pictures shown directly on our walls through self-lighting panels, and in 3-D!

FIGURE 1



"Truer than you Think"

Expedite — To confound confusion with commotion
Coordinator — The guy who has a desk between two expediters
Consultant — An ordinary guy 50 miles from his home office
Under consideration — Never heard of it
Under active consideration — We're looking in the files for it
To negotiate — To seek a meeting of minds without a knocking together of heads
Reorientation — Getting used to working again
Reliable source — The guy you just met
Informed source — The guy who told the guy you just met
Unimpeachable source — The guy who started the rumor originally
Clarification — Filling in the background with so many details that the foreground goes underground
We're making a survey — We need more time to think of an answer
Note and initial — Let's spread the responsibility for this
See me, or let's discuss — Come down to my office, I'm lonesome
Let's get together on this — I'm assuming you're as confused as I am
Give us the benefit of your present thinking — We'll listen to what you have to say as long as it doesn't interfere with what we've already decided to do
Will advise in due course — If we figure it out, we'll let you know
Giving someone the picture — A long, confused and inaccurate briefing to a newcomer
Herewith are forwarded — Or not, as the case may be, but your office will be to blame if the enclosures are missing
I approach the subject with an open mind — Completely ignorant of the whole subject
A growing body of opinion — Two very senior officers agree
Concur generally — Haven't read the paper and don't want to be bound by anything I say
Have you any remarks? — Can you give me any idea what this is all about?
This will be borne in mind — No further action will be taken until you remind me
In due course — Never

The boys of Theta Tau are proud to introduce Honolulu-bo
psychology major Miss Jane Bayol (Janie). Green-eye
brown-haired Janie has captured campus this year by holdi
the positions of co-captain of the cheer leaders, rush chairm
and pledge trainer of Delta Gamma Sorority, chairman of th
voting for this year's homecoming, and secretary to Dr. Virgini
Kirkbride, Director of Women's Activities.
This 20 year old Junior reaches the perky height of 5' 5", a
weighs a trim 115 pounds. Her main interests lie in the regio
of dancing, reading, and traveling. Although she has noth
definite planned for her future, she would like to contin
traveling around the world, having begun by living in Georg
Illinois, Virginia, and her native Honolulu.

MECH MISS

THETA TAU

"ENGINEERS' DAYS"

by Dulany de Butts

Fellow students — in the next few weeks you will be hearing about yourselves from engineers, and friends, over radio, television and in the newspapers, for you are the students at George Washington School of Engineering. It is well you know what you should say when the occasion arises to answer inquiries, inform acquaintances, and when you visit your high school.

Tell the public that your student body is holding an open house where the things that fascinate you in the new world of engineering will be explained. Make them realize that your interest makes it worth while for you to struggle with engineering school, and with all this be sure not to paint "Pollyanna's Dream" as a life of dreamy research in engineering. We know there is a lot of routine work to any job and that only a few will ever be able to do pure research. This is impartont for many youngsters think otherwise.

Invite anyone to attend Engineers' Days of Friday, February 23rd (9 A.M. to 9 P.M.) and of Saturday, February 24th (10 A.M. to 4 P.M.). Bring your family, neighbors, but above all don't take credit for the end accomplishment without helping out in preparing for the Engineers' Days. Did you know, several students who have been helping have found jobs through their efforts and many more have decided where they want to do advanced study too. The rewards are great. Ask your teacher, or come to the Davis-Hodgins House, 731 22nd Street, and ask what you can do.

Now, don't forget the dance of the year. The Engineers' Ball is your big night to howl - Saturday, 24th of February. It will be held at the Hamilton Hotel, 14th and K Streets, in downtown Washington, and the best band available has been selected. We will crown your Engineers' Queen and live it up for a change.

A list of exhibits and laboratory experiments will be posted on the bulletin boards. I will tell you this — there are 40 outside engineering and planning outfits who have volunteered to make this a big two days at your Engineering School. They are doing what they can for you. Now they want you to do something for yourselves.

MASSIVE GLASS RESISTORS

Glass resistors, produced by Corning Electronic Components, as big around as telephone poles are being used in point-to-point communications between Project Mercury tracking stations.

The resistors are four feet long. They serve as dummy antenna loads for testing and calibrating transmitters and as power dissipating terminations for rhombic and other transmitting antennas.

Corning said its massive resistors were chosen by Technical Materiel because of their very low and almost uniform reactance at high frequencies. They can be brought instantly to full rated output even at -40°C. They are effectively cooled by air convection, even at maximum rated operating temperature of 100°C, Corning said.

Because they are compact, less costly and practically unaffected by corrosion, the resistors replaced dissipating lines as terminations for rhombic antennas.

The resistors consist of a tin oxide film fused into Pyrex brand glass cylinders five inches in diameter. A silicone coating protects the unit. The resistive elements were spiraled according to specifications of Technical Materiel engineers to obtain specific ohmic values, uniform heat dissipation, and minimum series inductance and shunt capacitance for each individual installation.

For minimum installation effort and maintenance, the resistors are placed vertically in vented fiber glass-reinforced plastic cases designed for pole or frame mounting.

The equipment firm designed both balanced and unbalanced loads, using 140 and 300-ohm resistors to obtain 70 and 600-ohm impedances. The loads are used with the company's 10,000-watt and 40,000-watt transmitters.

Operating frequencies of the Mercury network lie between two and 28 megacycles. Even at the top of the range, reactance is virtually flat.

A total of 22 of the huge resistors are being used for the 16-station world-wide tracking network.

TECH NEWS

Edited by Larry C. Flice

SIMULATED SOLAR RADIATION

It has been recently confirmed that solar radiation beyond the earth's atmosphere can be precisely simulated in environmental space chambers bathed in both visible and invisible light from a bank of carbon arcs. Such chambers should prove invaluable research tools in the earth-bound evaluation of space vehicles and equipment.

The visible light of the carbon arc has long been regarded as man's closest approximation of sunlight, and is widely used in motion picture projection and studio lighting, and in the graphic arts fields of photo-engraving and photo-lithography. Technical data had previously been limited largely to the visible light wave-lengths, from 4000 to 7000 angstroms.

Using a Perkin-Elmer recording spectrophotometer, one of the few instruments capable of doing the job, engineers measured the spectral energy distribution of radiation from the carbon arc all the way out to 150,000 angstroms. Data were then plotted on a curve showing the spectral energy distribution of the sun outside the earth's atmosphere from 2500 to 60,000 angstroms, which includes from 98 to 99 percent of the sun's energy output. The two curves were found to follow each other very closely over the entire range.

Armed with this scientific confirmation, space equipment designers can now use banks of carbon arcs with no filters or added energy in test chambers to simulate conditions of solar radiation in outer space. Much of the sun's energy is absorbed by the atmosphere, and never reaches the earth. Once space vehicles are above an altitude of approximately 300 miles, however, the atmosphere is so rarefied as to absorb none of the sun's energy, and solar radiation becomes a critical factor in the operation of the vehicle, component parts, and such devices as solar cells that are used to convert the sun's energy into electrical power for the vehicle.

ALL-PLASTIC CAR

The Army is building an experimental, all-plastic car whose parts would be so cheap that

—Continued on page 16

HE WORKS WITH A NEW DIMENSION IN COMPUTER DESIGN

Thin film cryotrons may make possible computers of small size and truly prodigious speeds.

The speeds of today's computers are limited mainly by device switching times. Speeds of cryotron computers would be limited mainly by signal propagation times between devices.

Automation of Logical Circuits. Edward Sussenguth has studied methods of design which will reduce the distance between devices to a minimum. He hopes that these will contribute to a completely automatic design system.

Ultimately, then, the systems designer would specify his needs in terms of Boolean equations and feed them into a computer. The computer would (a) design the logical circuits specified by the equations, (b) translate the logical circuits into statements describing the interconnections, (c) from the interconnections, position the devices in an optimal fashion, (d) from this configuration, print out the masks to be used in the evaporation process by which these circuits are made.

This is a big order, but Edward Sussenguth and his colleagues have already made significant progress. Their work may well have a profound effect on computer systems in the coming years.

Orientation: the future. One of the exciting things about computer development is this orientation towards the future. If a man wants to match his personal growth with the growth of computer systems, his future can be virtually unlimited. This is true of all the fields associated with computer systems — research, development, manufacturing, programming, marketing. The IBM representative will be glad to discuss any one of these fields with you. Your placement office can make an appointment. All qualified applicants will be considered for employment without regard to race, creed, color or national origin. You may write, outlining your background and interests, to:

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CAMPUS NEWS

by Harvey Platt

The School of Engineering bowling team launched its season by beating Delta Tau Delta, with a set of 1852. Not only did they beat the Delts, but by being the only team to bowl three games over 600 - 630, 619, and 603 - they rolled a higher set than any other team in the league, which we hope is a good indication of how the season will turn out. Dave Bryant brought another honor to the team and to himself by bowling the high game for the day - 193. Other team members include: Judy Popowsky, Douglas Jones, Steve Caine, Floyd Mathews, and Arthur Nielsen. Games are bowled on Sundays at Pentagon City Sports Center, in Virginia. Why not stop by and cheer for our team.

December was a busy month for the engineering organizations in the School. Theta Tau held its semi-annual banquet and ball at the Holiday Inn. Since Theta Tau is not having a fall pledge class this year, the guests missed the usual entertainment in the form of a pledge skit, but fortunately the dates were not deprived of being serenaded by the brothers with the fraternity song. During the intermissions, Herb Wilkinson led the group in a song session. The highlight of the evening occurred when all the brothers and their dates were talked into trying to do the twist. Floyd Mathews said that he had a good time in spite of his sore feet. During its December meeting the fraternity elected Eliot Cohen Treasurer. Jerry Steffel was elected to the office of Corresponding Secretary.

It is not too early to start your project for Engineers Week. The reinforced concrete class, CE 146, has a headstart. They have already poured a pre-stressed, post-tension, reinforced concrete diving board, which is their undertaking for this occasion.

The professional societies held their monthly meetings, and unfortunately too few people were present to enjoy the excellent programs that were offered. After a brief business meeting, Mr. John Cannon of PEPCO, a G. W. graduate and perennial speaker and benefactor of the student chapter of the ASME, gave an informative talk on "Power

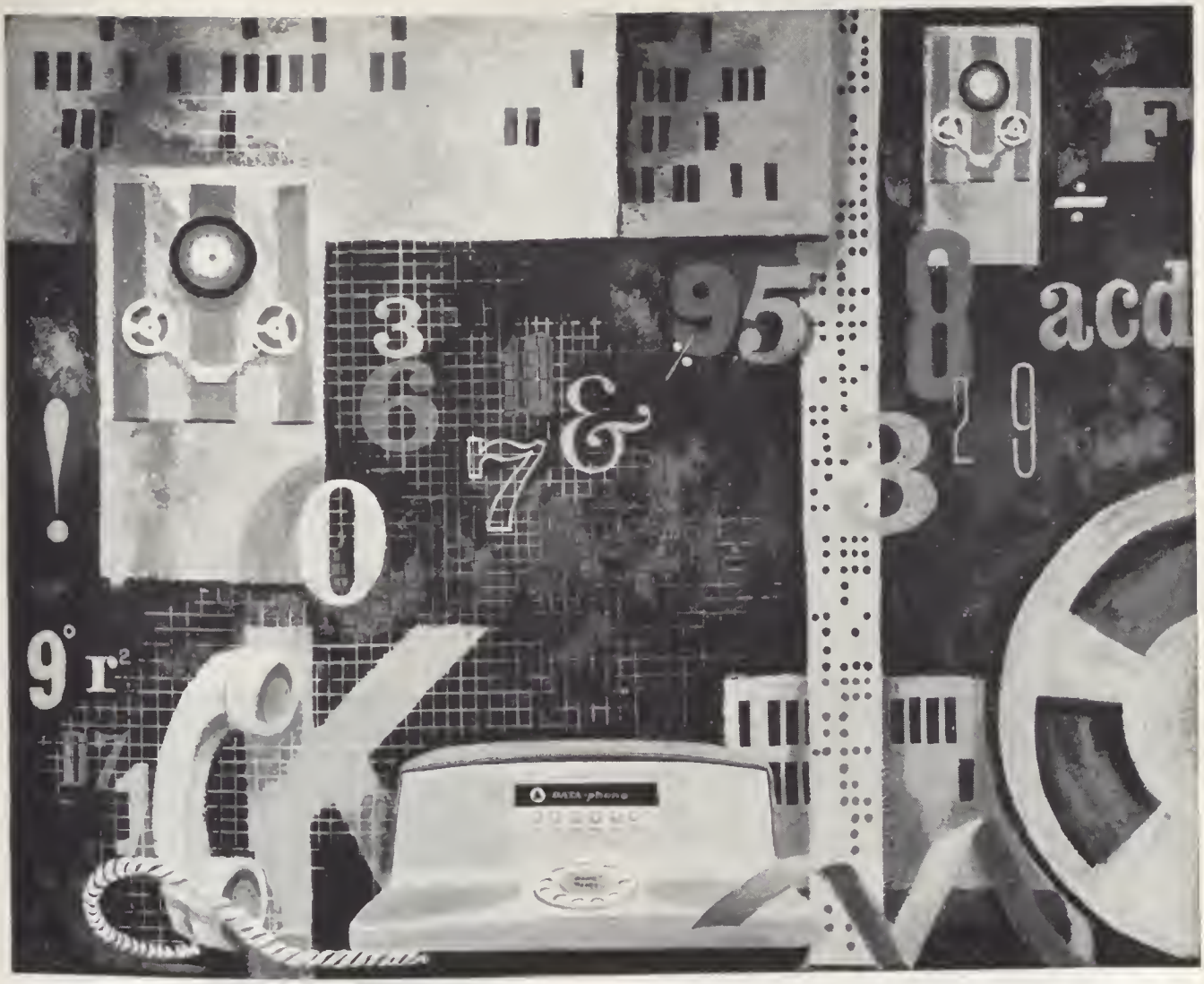
in Industry." Mr. Cannon's personal experiences in applied thermodynamics helped to make his talk very interesting. The civil engineers heard a talk on "City Planning," given by Mr. Douglas Porter of Blair Associates. Other ASCE activity in December included a meeting of the officers of the student chapter with Mr. Fisk, Assistant Secretary of the National Headquarters of ASCE. Mr. Fisk met with the group to offer his advice on local chapter problems. The AIEE-IRE invited Mr. Grant C. Riggle, head of the Electronics Section of the Instrumentation Engineering and Development Branch of N. I. H. Mr. Riggle's talk was on "Engineering Applications to Medicine." He pointed out that there are opportunities in this field for engineers other than just EE's. An interesting discussion on rockets and missiles took place during the usual coffee break which followed the meeting.

On December 2, Sigma Epsilon initiated four new members; Lee Kaminetzky, Donald A. Miller, Paul A. Oscar, and Paul E. Treynor. Also in December, Sigma Epsilon sent a preliminary petition to the Executive Council of Tau Beta Pi. Sometime in January, an inspection committee will visit our school to meet with the students and faculty members. If all goes well, the fraternity will submit its final petition to the National Convention of Tau Beta Pi, which meets in October.

At its November meeting, the Engineers' Council was very pleased to have Dean Mason as its guest. Dean Mason reminded the Council of its obligations to the student body. The Council passed a motion to buy School of Engineering decals. These will be given out at registration in February.

Sigma Tau will hold its fall Initiation Ball and Banquet on January 6. Dr. Dean Mann of the Brookings Institute will address the guests after dinner. After the talk the newly initiated members will receive their keys from Mr. Balwantz, chapter advisor.

Reminder: There are only forty shopping days left until the Engineers Ball February 24.



Bright futures in data transmission at W. E.

New engineers with initiative who can meet Western Electric's high standards are offered many exciting career opportunities with our company in data processing development work as it relates to communications.

For example, Western's engineers – working closely with Bell Telephone Laboratories–have solved development and manufacturing problems connected with the Bell System's new DATA-PHONE Data set (made by Western Electric). DATA-PHONE service lets business machines, such as computers, "speak" to each other in a language of numbers and symbols over existing telephone communication networks. This represents a tremendous boon to business; and consequently, it is estimated that some day there may be more machine talk than people talk using telephone lines.

Of course, data communications is only one of many rewarding career areas that await you at Western Electric. Here are just a few of the others: electronic switching . . . solid state electronic devices . . . microwave radio relay . . . computer-programmed production lines . . . solar cells . . . optical masers . . . futuristic telephones.

We need high-caliber, forward-thinking engineers now to help us transform these plans into realities or to work with us in scores of other key communications areas. Your future, the future of Western Electric, and the future of America's communications – could well depend on your first career connection.

Challenging appartunities exist now at Western Electric for electrical, mechanical, industrial, and chemical engineers, as well as physical science, liberal arts, and business majors. All qualified applicants will receive careful consideration far employment without regard to race, creed, calor ar natianal arigin. Far mare infarmation abaut Western Electric, write College Relatians, Western Electric Campany, Raam 6105, 222 Braadway, New Yark 38, New Yark. And be sure ta arrange far a Western Electric Interview when aur callege representatives visit your compus.

Western Electric

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even a failing engine would be thrown away rather than repaired. Production costs will be about $1,300, compared to a jeep's cost of about $3,500.

CONCRETE FROM COTTON

Russian chemists are making a concrete construction material from cotton-waste products. The Russians claim the material is three to seven times stronger than cement-based concretes and is fire, water and acid proof. In addition, they say the material insulates against heat and electricity.

GIANT RADIO TELESCOPE TO BE READY BY FEBRUARY

The radio-telescope with the largest reflector in the world -- 1,000 feet in diameter -- will be ready to probe the far reaches of the universe by next February. The facility, designed by Cornell University scientists for the Department of Defense, is under construction near Arecibo, Puerto Rico. The telescope will make it possible to study the upper atmosphere, the composition of space and the solar system by radar methods, as well as to send and receive radio signals from the far reaches of the universe.

The excavation for the giant radar dish has been completed and the concrete and steel pylons that will support the feeder system are under construction. The pylons, designed to withstand hurricane winds, will be about three hundred feet tall and thirty feet in diameter at their base.

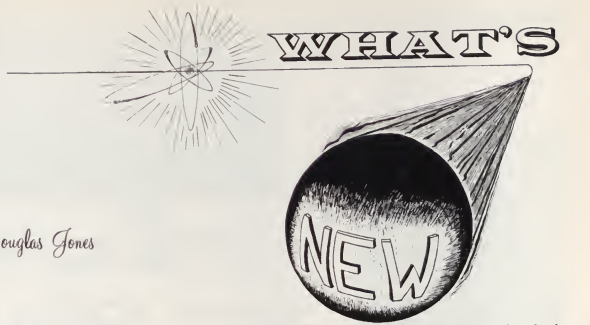
The estimated cost of the reflector and feed system is $4.1 million, while the entire project will cost $6,500,000, considerably less than similar installations because of the unique design. The Cornell designers have placed the reflector in a natural bowl, eliminating the need for massive steering machinery. The telescope is pointed by rotating the feed line.

Professor William E. Gordon of Cornell is in charge of the design and construction of the facility.

F-1 ROCKET ENGINE

The National Aeronautics and Space Administration's F-1 engine, the most powerful rocket unit known having a thrust of 1.5 million pounds, is being developed by Rocketdyne, a division of North American Aviation. It is possible that first use of the F-1 engine could be in an advanced Saturn booster designed to approximately double the power of the Saturn C-1 booster. One possible configuration would be powered by a cluster of two F-1's for a lift-off thrust of 3 million pounds developed by eight Rocketdyne H-1 engines. This configuration will carry the three man Apollo spacecraft in earth orbital scientific missions of up to two weeks. The second stage is the 90,000-pound thrust S-1V stage powered by six Pratt & Whitney RL-10-A3 liquid hydrogen-liquid oxygen engines. The advanced Saturn refered to above could be used to place the Apollo spacecraft into orbit about the moon and return it to earth. This possible configuration would be capable of lifting an approximate 30,000-pound pay-load on a lunar mission. The first complete engine test was made on June 13, 1961, at the $15 million high thrust test area of Edwards, Calif. Approximately one million pounds of thrust was generated at that time. This achievement was of high significance to the U. S. space effort. F-1 is the free world's most powerful space booster-engine; it may launch the first manned expedition to moon.

F-1 rocket engine developed by Rocketdyne



Edited by Douglas Jones

MINIATURE HELIUM EXPANSION TURBINE WITH GAS-LUBRICATED BEARINGS

The Cryogenic Engineering Laboratory of the National Bureau of Standards Boulder (Colo.) Laboratories has developed a miniature helium expansion turbine for operation in a helium liquefier or refrigerator. Rubbing friction and bearing wear have been eliminated in this device by replacing conventional rolling-element bearings with gas-lubricated journal and thrust bearings of the externally pressurized type. The life of these bearings should be indefinite, and the speed of the shaft supported by the bearings is limited only by the strength of the material.

In the production of refrigeration at liquid helium temperatures, the use of an expansion turbine eliminates the need for liquid hydrogen pre-cooling of the helium below the inversion point prior to expansion of the helium through a valve. The extra complication introduced by the expander is usually justified by the elimination of the explosion and fire hazard associated with liquid hydrogen. In small refrigerators and liquefiers it has been customary to use a reciprocating expansion engine because of the high speeds required of a turbine expander. These high turbine speeds are beyond the speed and life limits of conventional roller element bearings. However, this limitation does not apply to gas-lubricated bearings. In a properly designed gas bearing the shaft can be maintained in a position of stable equilibrium so that it never touches the surface of the bearing.

An analytical rather than a cut-and-dry approach to the design of the bearings has been developed. The bearings are provided with pneumatic phase-shift networks designed to ensure stability at extreme rotational speeds. During actual tests the shaft has been observed to be in a position of stable equilibrium at an operating speed of 3000 revolutions per second.

The miniature helium expansion turbine developed by the Bureau (Fig. 1) was designed for a refrigerator cycle having an expander inlet temperature of 17.6°K and flow rate of 530 SCFM. The inlet pressure is 15 atm and the outlet pressure is 1 atm. The turbine is of the mixed flow type — radial inlet and axial outlet. The rotor passages are of the impulse type, having a very small amount of reaction. The expansion ratio in the nozzle ring is about 10 and in the rotor about 1.6. A recompression ratio of about 1.07 is effected by the diffuser, thus accounting for an over-all expansion ratio of 15. The power generated by the turbine is absorbed by means of a centrifugal blower which acts as a brake. The blower operates in a closed circuit in series with a cooler and a throttle valve.

Both the journal and thrust bearing operate at room temperature, the turbine rotor being mounted on an extension of the shaft which overhangs into the cold region. The shaft is made of 410 stainless steel, chosen because of its low thermal conductivity and high tensile strength. The diameter of the shaft is the same as that of the turbine rotor — 7/8 in.; thus, the need for a heavily loaded thrust bearing is eliminated. The rotor design is unconventional, but fabrication is simple and problems arising from axial misalignment are minimized. The turbine was designed with simplicity of construction in view, so that, if required, much smaller turbines could be constructed along the same lines.

The turbine expander was tested over a wide range of conditions to determine its operating

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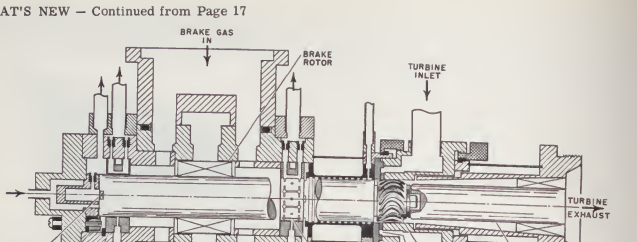

FIGURE 1

characteristics and to test the stability of the bearings. It is estimated that the turbine efficiency at design conditions should approach 60 percent. At a total flow rate to the turbine and gas-lubricated bearings of 180 SCFM, the journal bearings were found to absorb a flow of 37 SCFM, or 21.3 percent. As the bearings will operate warm in a low temperature installation and the total flow is estimated to be 530 SCFM, this gas flow to the bearings represents about 6.5 percent of the total flow. The gas-lubricated bearings were found to be stable and functioned properly at bearing supply pressures from 10 to 20 atmospheres.

The design of this turbine expander has proven to be satisfactory. The experimental tests showed that the gas-lubricated bearings are stable with the turbine operating at room temperature when producing up to 7 kilowatts of refrigeration. As the design load is approximately 3 kilowatts, the bearings should possess more than adequate stability under normal operating conditions. They should operate indefinitely when proper precautions are taken to provide clean supply gas. Such a design is quite adaptable to the application of a liquefaction or refrigeration cycle for trouble-free operation. The size of an expander such as this is limited only by practical fabrication techniques, which makes it adaptable to very small liquefaction or refrigeration cycles.

TO THE TUNE "TWAS LATE IN THE EVENING, THE GUESTS WERE ALL LEAVING, ETC."

I. "Twas early one morning
The sun was just dawning
As I worked on an AC report
When out of thin air
Came a wail of dispair
The data was six pages short.
I wept a sad tear
For I'm no engineer
And I'll never become one, it seems —
Hanrahan won't be happy
With data so scrappy
The Deacon, he walks in my dreams.

CHORUS: My advisor never told me
The things a freshman should know
About the ways of EE profs
And how they deal out woe,
So remember your friends and brothers
And teach them all the tricks
Tell 'em stay away from EE
They'll be much better off laying bricks.

II. Then shortly past noonrise
With headache full kingsize
I struggle to figure the quirks
Of problems so knotty
They've driven me dotty
The subject? You guessed it: NETWORKS
Then out of the night
Came an idea so bright:
A high voltage line I attached
From my leg to my head
But I didn't fall dead
It seems that the load was mismatched!

III: 'Twas late in the morning
When I remembered forelorning
A hydraulics quiz I had,
I jumped for my textbook
And there one quick look
Told me I had been had
CE quizzes are hazards
with _____ their _____
They make an EE's lot sad.

• One in a series of messages on how to plan your career

Hopping or marching—two paths to a career

A career is sometimes defined as a succession of jobs, whether with a succession of employers, or within a single company.

A man is commonly said to be "hopping" when he progresses by switching from one employer to another.

The man who sticks with a single employer can be said to progress by "marching."

Marching Pays Off—There are many advantages to a one-company career. It's obvious that tenure is accompanied by status, security, and benefits that build in value as the years go by. More significant, perhaps, are the *intangibles.* You can't put a dollar value on your familiarity with the organization and the people in it. And the respect they have for you is equally important. The man who is dedicated to his employer, and confident of his ability to progress without looking afield, is free of distracting tensions, free to concentrate his full energies on the job at hand. And, especially to the family man, just "being settled" is mighty reassuring.

Finding the Right Employer — The problem facing a graduating senior is to locate a prospective employer that offers an ambitious man promising opportunities for a truly rewarding and satisfying career. The best answer we know of is to look for a company with a firm policy of "promotion from within." And a second consideration is the size and scope of the organization.

Loopers are Career Men—Every year Bethlehem Steel Company enrolls a group of graduating seniors in the Loop Course—the entire class makes an observational circuit (or "loop") of a steel plant during the basic training period. We select qualified men for the Loop Course on the basis of their potential for careers in management, and we train them accordingly. There are about 2,000 loopers on the job at Bethlehem, at all supervisory levels, and in all of our diverse operations.

The Loop Course—New loopers report to our general headquarters, in Bethlehem, Pa., usually early in July. They attend a basic course of five weeks, including lectures, classroom discussions, educational films, and daily plant visits. The Loop Course is *not* a probationary period. After completion of the course, every looper receives his first assignment. Then, after reporting to a plant, yard, or home office division, he receives further orientation before beginning on-the-job training. Bethlehem loopers embark on their careers with thorough training behind them.

Big and Diversified—Because of its size and diversity, Bethlehem Steel offers unlimited opportunities to "get ahead." One of the nation's largest industrial corporations, with over 140,000 employees, we are engaged in raw materials mining and processing; basic steelmaking and the production of a wide range of steel products; manufacturing; structural-steel fabricating and erecting; and shipbuilding and ship repair. A new centralized research facility, the Bethlehem Steel Company-Homer Research Laboratories, costing in excess of $25 million, located in Bethlehem, Pa., rivals the finest in any industry.

Read Our Booklet—The eligibility requirements for the Loop Course, as well as a description of the way it operates, are more fully covered in our booklet, "Careers with Bethlehem Steel and the Loop Course." It will answer most of your questions. Copies are available in most college placement offices, or may be obtained by writing to Manager of Personnel, Bethlehem Steel Company, Bethlehem, Pa.

All qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin.

BETHLEHEM STEEL

BETHLEHEM STEEL

ALUMNI PAGE

Edited by

John Wolfgang

This month's Alumni News is dedicated to the classes of '34 through '39

Paul S. Schaffer BSE '35
Agriculturalist, U.S. Department of Agriculture, Brookeville, Maryland

Frank E. Bailey BME '35
Assistant Chief, U.S. Patent Office, Washington, D. C.

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Ben Reznek BME '35
Chief of Environmental Testing, Diamond Ordnance Fuze Laboratory, Washington, D. C.

Dyer Ghormley BCE '35
General Produce Manager, Carnation Co., Pacific Palisades, California

William G. White BSE '36
President of Consolidated Freightways, Inc., Atherton, California

Gilbert A. Engen BCE '36
Supervisory Cartographer, U. S. Navy Hydrographic Office, Washington, D. C.

Carl H. Roeder BME '37
Retired from National Bureau of Standards in 1952. Now resides in Silver Spring, Maryland.

Walter F. Rhine BCE '37
Engineer for Barge-Thompson, Inc., Atlanta, Georgia

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Assistant Chief Electrical Engineering Division, Rural Electrification Administration, Washington, D. C.

James C. Robertson, Jr. BCE '38
Superintendent of Construction & Repair Division, Dept. of Sanitary Engineering, Washington, D. C.

Milton A. Sheppa BME '38
Assistant for supporting Research, Department of Navy BUWEPS, Arlington, Virginia

Merwyn N. McKnight BME '38 BEE '41
Retired from the Navy Department.

Leon Commerford, Jr. BCE '38
Col., Corps of Engineers, United States Army

Herbert F. Mitchell, Jr. BEE '38
Regional Systems Sales Mgr., Minneapolis-Honeywell Reg. Co., Hollywood, Calif.

Raymond F. Muth, Sr. BME '38
Industrial Manager, U.S. Naval Ordnance Plant, York, Pennsylvania

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Senior Application Engineer, The Marquardt Corp., Van Nuys, California

Magnus Anda BSE '39
Retired, Petersburg, Florida

Charles E. Walden BSE '39
General Engineer, U. S. Naval Ordnance Test Station, China Lake, California

Edward A. Schmitt BCE '34
Retired from the Corps of Engineers, United States Army, Chevy Chase, Maryland

ΣE ΣE ΤΒΠ

SIGMA EPSILON PETITIONS

ΤΒΠ

FOR MEMBERSHIP IN TAU BETA PI

ΣE

by Herb Wilkinson ΤΒΠ

One group within the School of Engineering is not pausing to look back over the year 1961 and to reminisce about its successes and failures, as often happens when December rolls around. Sigma Epsilon is anxiously looking ahead to 1962, the year in which this local honor society becomes eligible for membership in the largest national engineering honor society, Tau Beta Pi.

The school should indeed be proud of this small group of students who, in two short years, under the supervision of interested faculty members, have met with all the preliminary requirements needed to qualify as candidates for membership in the nationally recognized Tau Beta Pi Association. The entire university, as well as the School of Engineering, shall receive national recognition if Sigma Epsilon achieves its goal; the George Washington University will take its rightful place among the famous universities and colleges of this nation who recognize, encourage, and honor high scholastic achievement by conferring Tau Beta Pi membership on their outstanding engineering students.

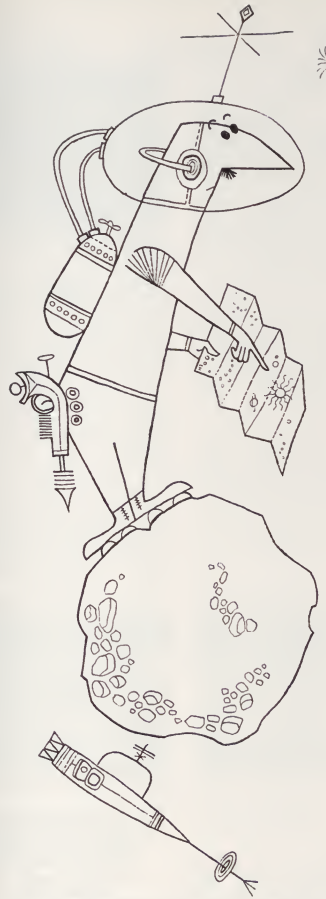
Many of the students present in the school today are not aware of the manner in which Sigma Epsilon began or how it has reached its present prominence. The society actually was conceived by a committee of interested faculty members, many of whom were Tau Beta Pi members. The faculty saw the need of a society which would recognize those students with extremely high scholastic achievement. At that time, the only honor fraternity for engineering students was Sigma Tau, which honored those undergraduates who ranked in the upper one-third of their respective classes. Although this society very effectively served its purpose, there was no special recognition for the top students, scholastically, in each class. (In many universities and colleges, Phi Beta Kappa serves in this manner, but at the George Washington University only liberal arts students are eligible for this honorary.)

A society such as Tau Beta Pi would serve to honor the students possessing the highest scholastic records and would give recognition to the top one-fifth of the senior class, as well as the top one-eighth of the junior class. The faculty contacted the Association and obtained the information necessary in order that a local engineering honor society could be formed. After two years of successful operation, the local society would be eligible to petition Tau Beta Pi for membership; if certain standards were achieved, a chapter would be granted to G.W.U.

The twenty charter members of Sigma Epsilon were chosen by a faculty committee in April of 1960. At this time, the students took over the leadership, under the Advisory Board of four faculty members. Fifteen additional members have been added and the society presently is under the capable leadership of President Howard T. Hill.

This coming January, a committee from Tau Beta Pi will visit this university and investigate the worthiness of Sigma Epsilon and the School of Engineering as actual members of Tau Beta Pi. If this visit turns out favorable, the national meeting of Tau Beta Pi will determine the final outcome of Sigma Epsilon's petition.

Therefore we all should be proud of Sigma Epsilon and do our utmost to support its petition. Just remember that, as undergraduates, we all will be eligible for membership provided we hit the books hard enough.



how far is "way out"?

Like about 239,000 miles if you're part of the scientific team at Ford Motor Company's Aeronutronic Division in Newport Beach, California.

A leader in missile development, Aeronutronic was assigned to build the U.S.'s first moon capsule for the NASA Ranger lunar exploration program. This 300-pound instrumented package will be launched by a larger spacecraft for impact on the moon's surface where it will transmit computer data to earth.

Meanwhile, back on this planet, men and ideas are in constant motion at Aeronutronic, planning scientific break-throughs which will effectively transform new concepts into practical products for industry and defense.

Aeronutronic has been awarded prime contracts for the Air Force "Blue Scout" rocket-space program; the development of DECOYS in the Air Force ICBM program; SHILLELAGH surface-to-surface guided missiles for the Army.

Ford Motor Company recognizes the vital relationship of science to national security. Through our Aeronutronic Division supplemented by our scientific research and engineering facilities at Dearborn, Michigan, we actively support long-range basic research as an indispensable source of today's security and tomorrow's products. *This is another example of Ford's leadership through scientific research and engineering.*

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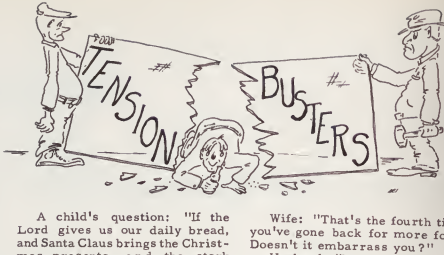


At a wedding not long after World War II the groom, only recently back from overseas, had hardly glimpsed his bride before the ceremony. Therefore, when time came for the kiss, it was a long one, lasting on and on, until a child's voice rang out in the silence of the church:

"Mummy, is he spreading the pollen on her now?"

A young lady with a touch of hay fever took with her to a dinner party two handkerchiefs, one of which she stuck in her bosom. At dinner she began rummaging to right and left in her bosom for the fresh handkerchief. Engrossed in her search, she suddenly realized that conversation had ceased and people were watching her, fascinated.

In her confusion she murmured, "I know I had two when I came."

The middle-aged man was shuffling along, bent over at the waist, as his wife helped him into the doctor's waiting room. A woman in the office viewed the scene with sympathy. "Arthritis with complications?" she asked.

The wife shook her head. "Do-it-yourself," she explained, "with concrete blocks."

Parson Webster phoned the local Board of Health to ask that a dead mule be removed from the front of his house. The young clerk thought he'd be smart.

"I thought you ministers took care of the dead," he remarked.

"We do," answered Parson Webster, "but first we get in touch with the relatives."

On the job application blank was the question, "Have you ever been arrested." The applicant put down, "No." The next question was "Why" — meant for those who had been arrested. Not realizing this, the applicant put down, "Never been caught."

A child's question: "If the Lord gives us our daily bread, and Santa Claus brings the Christmas presents, and the stork brings the babies, what's the use of having daddy around?"

Two sheep were grazing in a meadow. One of them stopped eating and looked up.

"Baaaaaaa-a-a," it said. The other stopped, then replied:

"Moooooooo!"

"What do you mean - 'moo'?" asked the first.

"I'm studying a foreign language."

The bright young high school graduate applied for his first full-time job. He read the application blank which asked:

"What machines can you operate?"

After a moment's thought he wrote:

"Slot and pinball."

Prospective Father-in-Law: "Young man, are you sure you can support a family?"

Suitor: Well, no sir. I was just planning to support your daughter. The rest of you will just have to shift for yourselves."

Doctor: "Why do you have that A-5967 tattooed on your back?"

Patient: "That's not tattooed. That's where my wife ran into me while I was opening the garage door."

Asked to write a brief essay on the life of Benjamin Franklin, one little girl wrote this gem of a paragraph:

"He was born in Boston, travelled to Philadelphia, met a lady on the street, she laughed at him, he married her, and discovered electricity."

Wife: "That's the fourth time you've gone back for more food. Doesn't it embarrass you?"

Husband: "No, I tell them I'm getting it for you.

The doctor came out of the bedroom and spoke to the anxious wife. "Frankly," he said, "I don't like the way your husband looks at all."

"Well," replied the wife, "neither do I, but he's nice to the kids."

A Russian track coach, interviewed by an American sports-writer, was asked why the Soviets are now producing such fast runners.

"It's really quite simple," the coach replied. "We use real bullets in our starting guns."

An announcer on a local radio station delighted his audience with the following launderette commercial: "Ladies who care to drive by and drop off their clothes will receive prompt and individual attention."

At the end of a program in the Famous Romances series, the Wedding March throbbed and faded, and the MC spoke through happy tears, "So ends another virgin....."

Little boy to mother: "Mom, can Freddie and I go out and listen to Daddy put the tire chains on?"

Wife to husband: "If we continue to save at our present rate, at retirement we will owe two million dollars."

Kodak beyond the snapshot . . .

(random notes)

Light as air

Both beakers contain the same quantity of applesauce. The picture should interest the millions who face the problem of avoiding more calories than their doctors say are good for them while enjoying the delight of good eating.

The one on the right contains only two additional ingredients: 1% of a certain type of monoglyceride fat we distill for the food industry and 1000% of air. Both added ingredients are harmless as applesauce itself.

One adds the monoglyceride, warms, and whips. If the result is a bit too airy for the common taste, one can either use more strongly flavored applesauce, freeze while mixing (as in making ice cream), or both.

It doesn't have to be applesauce. We have made the idea work just as well with bananas, tomato juice, etc.

Mind you, expect no applesauce from us. We offer no foods in family-sized quantities. We work closely, however, with companies that do.

THIS paper

"My husband sells oscillograph paper. Competition is fierce. He comes home beat every night."

Few overhearing her would know what the poor soul is talking about, yet she speaks the truth. Oscillographs probably outnumber pickle barrels in this country at present. Oscillographers are correspondingly numerous. Methods that one sect of oscillographers prefers above all else another sect can't see for dirt. One sect prefers automatic oscillogram processors. Paper manufacturers like us find their favor worth competing for. Therefore we announce a new advance in media for their use.

An advance in the old art of papermaking came first. Then new emulsions were devised to work properly with the new base. Then proper processing chemicals were devised for the new emulsions. Then the combination was extensively proved out under practical conditions of use by parties interested only in end-results and hardly at all in the how and why.

They found that THIS paper dries thoroughly at high processor speeds without creases, doesn't crack or distort, isn't fussy about how long it sits around *before* use, and gives trace lines that stand out black as the ace of spades.

"THIS" won't do for a trademark. We call it Kodak Ektaline Paper. Kodak Ektaline Chemicals come as liquids. The stabilization principle used in the automatic oscillogram processors came from Kodak, too.

Smart hardware

Alarm prevails over the nation's bill for research unwittingly repeated. We have an answer. Even the hardware is all built. It uses little chips of film 16mm by 32mm, which are never touched by human hands.

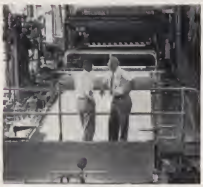
Each of the millions of chips carries both a) language the machines can use in classifying information to almost any depth of detail and b) microreproduction of documents, photographs, manuscripts, drawings, or whatever for the human user to examine with his natural-born eyes as soon as the machine has "remembered" it and restored it to size.

The machines search very fast. They further save searching time because of the incredible information-packing density and copying speed of photography. It is practical for the machinery to duplicate each complete chip for every pertinent sub-classification. The sub-classifications can therefore be made so fine that each contains relatively few chips for the machinery to zip through.

This is called the Minicard System. It can occupy legions upon legions of creative minds with very sharply relevant information from the whole recorded past while the stroke of genius is patiently awaited.

Note: Whether you work for us or not, photography in some form will probably have a part in your work as years go on. Now or later, feel free to ask for Kodak literature or help on anything photographic.

FOOD TECHNOLOGY NEEDS GOOD PEOPLE



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Interview with General Electric's Dr. J. H. Hollomon

Manager—General Engineering Laboratory

Society Has New Needs and Wants—Plan Your Career Accordingly

DR. HOLLOMON is responsible for General Electric's centralized, advanced engineering activities. He is also an adjunct professor of metallurgy at RPI, serves in advisory posts for four universities, and is a member of the Technical Assistance panel of President Kennedy's Scientific Advisory Committee. Long interested in emphasizing new areas of opportunity for engineers and scientists, the following highlights some of Dr. Hollaman's opinions.

Q. Dr. Hollomon, what characterizes the new needs and wants of society?

A. There are four significant changes in recent times that characterize these needs and wants.

1. The increases in the number of people who live in cities: the accompanying need is for adequate control of air pollution, elimination of transportation bottlenecks, slum clearance, and adequate water resources.

2. The shift in our economy from agriculture and manufacturing to "services": today less than half our working population produces the food and goods for the remainder. Education, health, and recreation are new needs. They require a new information technology to eliminate the drudgery of routine mental tasks as our electrical technology eliminated routine physical drudgery.

3. The continued need for national defense and for arms reduction: the majority of our technical resources is concerned with research and development for military purposes. But increasingly, we must look to new technical means for detection and control.

4. The arising expectations of the peoples of the newly developing nations: here the "haves" of our society must provide the industry and the tools for the "have-nots" of the new countries if they are to share the advantages of modern technology. It is now clearly recognized by all that Western technology is capable of furnishing the material goods of modern life to the billions of people of the world rather than only to the millions in the West.

We see in these new wants, prospects for General Electric's future growth and contribution.

Q. Could you give us some examples?

A. We are investigating techniques for the control and measurement of air and water pollution which will be applicable not only to cities, but to individual households. We have developed, for example, new methods of purifying salt water and specific techniques for determining impurities in polluted air. General Electric is increasing its international business by furnishing power generating and transportation equipment for Africa, South America, and Southern Asia.

We are looking for other products that would be helpful to these areas to develop their economy and to improve their way of life. We can develop new information systems, new ways of storing and retrieving information, or handling it in computers. We can design new devices that do some of the thinking functions of men, that will make education more effective and perhaps contribute substantially to reducing the cost of medical treatment. We can design new devices for more efficient "paper handling" in the service industries.

Q. If I want to be a part of this new activity, how should I plan my career?

A. First of all, recognize that the meeting of needs and wants of society with products and services is most important and satisfying work. Today this activity requires not only knowledge of science and technology but also of economics, sociology and the best of the past as learned from the liberal arts. To do the engineering involved requires, at least for young men, the most varied experience possible. This means working at a number of different jobs involving different science and technology and different products. This kind of experience for engineers is one of the best means of learning how to conceive and design —how to be able to meet the changing requirements of the times.

For scientists, look to those new fields in biology, biophysics, information, and power generation that afford the most challenge in understanding the world in which we live.

But above all else, the science explosion of the last several decades means that the tools you will use as an engineer or as a scientist and the knowledge involved will change during your lifetime. Thus, you must be in a position to continue your education, either on your own or in courses at universities or in special courses sponsored by the company for which you work.

Q. Does General Electric offer these advantages to a young scientist or engineer?

A. General Electric is a large diversified company in which young men have the opportunity of working on a variety of problems with experienced people at the forefront of science and technology. There are a number of laboratories where research and advanced development is and has been traditional. The Company offers incentives for graduate studies, as well as a number of educational programs with expert and experienced teachers. Talk to your placement officers and members of your faculty. I hope you will plan to meet our representative when he visits the campus.

A recent address by Dr. Hollaman entitled "Engineering's Great Challenge — the 1960's," will be of interest to most Juniors, Seniors, and Graduate Students. It's available by addressing your request to: Dr. J. H. Hollaman, Section 699-2, General Electric Company, Schenectady 5, N.Y.

GENERAL ELECTRIC

All applicants will receive consideration for employment without regard to race, creed, color, or national origin.